

CLAIMS

1. A haloaluminoxane composition wherein the halogen is fluorine, chlorine, and/or bromine, and wherein the amount of halogen atoms present in said composition is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms.

2. A composition according to Claim 1 wherein said composition is formed from components comprising

(a) at least one aluminoxane and

(b) at least one halogenation agent which is

(i) at least one halohydrocarbon of the formula R_nCX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R is, independently, a hydrogen atom or a hydrocarbyl group having from one to about twenty carbon atoms;

or

(ii) at least one siloxane having at least one labile halogen atom in the molecule, wherein each halogen atom is, independently, fluorine, chlorine, or bromine;

or

(iii) at least one silane of the formula R'_nSiX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms,

or

(iv) at least one tin compound of the formula R'_nSnX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(v) at least one hydrocarbyl aluminum halide of the formula R''_mAlX_{3-m} , where $m = 1$ or 2 , where X is, independently, fluorine, chlorine or bromine, and where R'' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(vi) mixtures of any two or more of (i)-(v).

3. A composition according to Claim 1 wherein the amount of halogen atoms present in said composition is in the range of about 2 mole % to about 10 mole % relative to aluminum atoms.

4. A composition according to Claim 1 wherein the halogen is fluorine.
5. A composition according to Claim 2 wherein (b) is at least one halohydrocarbon.
6. A composition according to Claim 2 wherein said haloaluminum composition is a partially halogenated aluminum.
7. A composition according to Claim 6 wherein (b) is at least one siloxane, silane, tin compound, or hydrocarbyl aluminum halide.
8. A composition according to Claim 2 wherein the hydrocarbyl groups of said aluminum are saturated, and have from one to about twenty carbon atoms.
9. A composition according to Claim 2 wherein said aluminum is methylaluminum, ethylaluminum, n-butylaluminum, or isobutylaluminum.
10. A composition according to Claim 5 wherein said halohydrocarbon is one in which at least one R is an aryl group.
11. A composition according to Claim 10 wherein said halohydrocarbon is α,α,α -trifluorotoluene.
12. A composition according to Claim 5 wherein said aluminum is methylaluminum, ethylaluminum, n-butylaluminum, or isobutylaluminum, and wherein said halohydrocarbon is one in which at least one R is an aryl group.
13. A composition according to Claim 5 wherein said aluminum is methylaluminum, ethylaluminum, n-butylaluminum, or isobutylaluminum, and wherein said halohydrocarbon is α,α,α -trifluorotoluene.
14. A composition according to Claim 13 wherein said haloaluminum is an ionic haloaluminum complex.

15. A composition according to Claim 13 wherein said haloaluminumoxane is a partially halogenated aluminumoxane.

16. A composition according to Claim 7 wherein said halogenation agent is a silane.

17. A composition according to Claim 7 wherein said halogenation agent is a silane, and wherein said silane is triphenylfluorosilane or trimethylfluorosilane.

18. A composition which comprises a haloaluminumoxane composition as in Claim 2 supported on a catalyst support or carrier.

19. A composition as in Claim 18 wherein said inorganic support or carrier is silica, alumina, or silica-alumina.

20. A composition according to Claim 18 wherein said aluminumoxane is methylaluminumoxane, ethylaluminumoxane, n-butylaluminumoxane, or isobutylaluminumoxane.

21. A composition according to Claim 18 wherein (b) is at least one halohydrocarbon, and wherein said halohydrocarbon is one in which at least one R is an aryl group.

22. A composition according to Claim 18 wherein said aluminumoxane is methylaluminumoxane, ethylaluminumoxane, n-butylaluminumoxane, or isobutylaluminumoxane, wherein (b) is at least one halohydrocarbon, and wherein said halohydrocarbon is one in which at least one R is an aryl group.

23. A composition according to Claim 22 wherein said halohydrocarbon is α,α,α -trifluorotoluene, and wherein said catalyst support or carrier is silica.

24. A composition according to Claim 7 wherein said aluminumoxane is methylaluminumoxane, ethylaluminumoxane, n-butylaluminumoxane, or isobutylaluminumoxane; wherein said halogenation agent is a siloxane; and wherein said siloxane is a trisiloxane or a tricyclosiloxane.

25. A composition according to Claim 7 wherein said halogenation agent is a siloxane, and wherein said siloxane is 3,3,3-trifluoropropylheptamethyltrisiloxane, 3,3,3-trifluoropropylheptamethylcyclotrisiloxane, or poly[methyl(3,3,3-trifluoropropyl)siloxane].

26. A composition according to Claim 25 wherein said aluminosiloxane is methylaluminosiloxane, ethylaluminosiloxane, n-butylaluminosiloxane, or isobutylaluminosiloxane.

27. A composition according to Claim 18 wherein said haloaluminosiloxane composition is a partially halogenated aluminosiloxane.

28. A composition according to Claim 27 wherein said aluminosiloxane is methylaluminosiloxane, ethylaluminosiloxane, n-butylaluminosiloxane, or isobutylaluminosiloxane, and wherein said inorganic support or carrier is silica, alumina, or silica-alumina.

29. A composition according to Claim 27 wherein said aluminosiloxane is methylaluminosiloxane, ethylaluminosiloxane, n-butylaluminosiloxane, or isobutylaluminosiloxane; wherein said halogenation agent is a siloxane; and wherein said siloxane is a trisiloxane or a tricyclosiloxane.

30. A composition according to Claim 27 wherein said halogenation agent is a siloxane, and wherein said siloxane is 3,3,3-trifluoropropylheptamethyltrisiloxane, 3,3,3-trifluoropropylheptamethylcyclotrisiloxane, or poly[methyl(3,3,3-trifluoropropyl)siloxane].

31. A composition according to Claim 30 wherein said aluminosiloxane is methylaluminosiloxane, ethylaluminosiloxane, n-butylaluminosiloxane, or isobutylaluminosiloxane.

32. A composition according to Claim 27 wherein said aluminosiloxane is methylaluminosiloxane; wherein said halogenation agent is a siloxane, wherein said siloxane is poly[methyl(3,3,3-trifluoropropyl)siloxane], and wherein said support is silica.

33. A process which comprises mixing, in an inert, anhydrous environment,
 (a) at least one aluminosiloxane and
 (b) at least one halogenation agent which is
 (i) at least one halohydrocarbon of the formula R_nCX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R is, independently, a hydrogen atom or a hydrocarbyl group having from one to about twenty

carbon atoms;

or

(ii) at least one siloxane having at least one labile halogen atom in the molecule, wherein each halogen atom is, independently, fluorine, chlorine, or bromine;

or

(iii) at least one silane of the formula R'_nSiX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(iv) at least one tin compound of the formula R'_nSnX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(v) at least one hydrocarbyl aluminum halide of the formula R''_mAlX_{3-m} , where $m = 1$ or 2 , where X is, independently, fluorine, chlorine or bromine, and where R'' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(vi) mixtures of any two or more of (i)-(v);

wherein the amount of halogen atoms is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms, such that a haloaluminosiloxane composition is formed.

34. A process according to Claim 33 wherein (b) is at least one haloalkane.

35. A process according to Claim 33 wherein said haloaluminosiloxane composition is a partially halogenated aluminosiloxane.

36. A process according to Claim 35 wherein (b) is at least one siloxane, silane, tin compound, or hydrocarbyl aluminum halide.

37. A process according to Claim 33 wherein said inert, anhydrous environment is an anhydrous liquid hydrocarbon solvent.

38. A process according to Claim 37 wherein said anhydrous liquid hydrocarbon solvent is an aromatic hydrocarbon.

39. A process according to Claim 38 wherein said aromatic hydrocarbon is toluene.
40. A process according to Claim 33 wherein the hydrocarbyl groups of said aluminoxane are saturated, and have from one to about twenty carbon atoms.
41. A process according to Claim 33 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane.
42. A process according to Claim 34 wherein said halohydrocarbon is one in which at least one R is an aryl group.
43. A process according to Claim 34 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane, and wherein said halohydrocarbon is one in which at least one R is an aryl group.
44. A composition according to Claim 34 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane, and wherein said halohydrocarbon is α,α,α -trifluorotoluene.
45. A process according to Claim 34 wherein said aluminoxane is methylaluminoxane; wherein said halohydrocarbon is α,α,α -trifluorotoluene; and wherein said inert, anhydrous environment is toluene.
46. A process according to Claim 45 wherein said haloaluminoxane is an ionic haloaluminoxane complex.
47. A process according to Claim 45 wherein said haloaluminoxane is a partially halogenated aluminoxane.
48. A process according to Claim 36 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane; wherein said halogenation agent is a siloxane; and wherein siloxane is a trisiloxane or a tricyclosiloxane.

49. A process according to Claim 36 wherein said halogenation agent is a siloxane, and wherein said siloxane is 3,3,3-trifluoropropylheptamethyltrisiloxane, 3,3,3-trifluoropropylheptamethylcyclotrisiloxane, or poly[methyl(3,3,3-trifluoropropyl)siloxane].

50. A process according to Claim 49 wherein said aluminoxane is methylaluminoxane, ethylaluminoxane, n-butylaluminoxane, or isobutylaluminoxane.

51. A process according to Claim 36 wherein said aluminoxane is methylaluminoxane; wherein said halogenation agent is a siloxane, wherein said siloxane is poly[methyl(3,3,3-trifluoropropyl)siloxane]; and wherein said inert, anhydrous environment is toluene.

52. A process according to Claim 36 wherein said halogenation agent is a silane.

53. A process according to Claim 36 wherein said halogenation agent is a silane, and wherein said silane is triphenylfluorosilane or trimethylfluorosilane.

54. A process according to Claim 33 further comprising forming a supported haloaluminoxane by

- A) contacting said haloaluminoxane composition with a support material, or
 - B) contacting a support material with (a) and (b)
- such that a supported haloaluminoxane is formed.

55. A composition formed from interaction between components comprising (I) either a haloaluminoxane wherein the amount of halogen atoms is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms, or

- (a) at least one aluminoxane and
- (b) at least one halogenation agent which is
 - (i) at least one halohydrocarbon of the formula R_nCX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R is, independently, a hydrogen atom or a hydrocarbyl group having from one to about twenty carbon atoms;

or

- (ii) at least one siloxane having at least one labile halogen atom in the molecule, wherein each halogen atom is, independently, fluorine, chlorine, or bromine;

or

(iii) at least one silane of the formula R'_nSiX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(iv) at least one tin compound of the formula R'_nSnX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(v) at least one hydrocarbyl aluminum halide of the formula R''_mAlX_{3-m} , where $m = 1$ or 2 , where X is, independently, fluorine, chlorine or bromine, and where R'' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(vi) mixtures of any two or more of (i)-(v),
wherein the amount of halogen atoms is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms;

and

(II) at least one catalyst compound or complex of a transition metal of Groups 3 to 11 including the lanthanide series and the actinide series.

56. A process for forming a catalyst composition which comprises interacting, in an inert aromatic solvent, components comprising

(I) either a haloaluminoxane wherein the amount of halogen atoms is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms, or

(a) at least one aluminoxane and

(b) at least one halogenation agent which is

(i) at least one halohydrocarbon of the formula R_nCX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R is, independently, a hydrogen atom or a hydrocarbyl group having from one to about twenty carbon atoms;

or

(ii) at least one siloxane having at least one labile halogen atom in the molecule, wherein each halogen atom is, independently, fluorine, chlorine, or bromine;

or

(iii) at least one silane of the formula R'_nSiX_{4-n} , where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(iv) at least one tin compound of the formula $R'_n\text{SnX}_{4-n}$, where $n = 1-3$, X is, independently, fluorine, chlorine or bromine, and where R' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(v) at least one hydrocarbyl aluminum halide of the formula $R''_m\text{AlX}_{3-m}$, where $m = 1$ or 2 , where X is, independently, fluorine, chlorine or bromine, and where R'' is, independently, a hydrocarbyl group having from one to about twenty carbon atoms;

or

(vi) mixtures of any two or more of (i)-(v),
wherein the amount of halogen atoms is in the range of about 0.5 mole % to about 15 mole % relative to aluminum atoms;

and

(II) at least one catalyst compound or complex of a transition metal of Groups 3 to 11 including the lanthanide series and the actinide series.

57. A process according to Claim 56 further comprising forming a supported catalyst composition by

- A) contacting a support material with (I) and (II), or
 - B) contacting (I) with a support material, or
 - C) contacting (II) with a support material, or
 - D) contacting said catalyst composition with a support material,
- such that a supported catalyst composition is formed.

58. A process of producing a polyolefin polymer, which process comprises polymerizing at least one polymerizable olefinic monomer in the presence of a catalyst composition comprised of a composition of Claim 55.